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COMPARATIVE STUDIES ON THE MORPHOLOGY, ANATOMY OF *CROTON BONPLADIANUM*BAILL AND *MICROCOCCAMERCURIALIS*(L) BENTH(EUPHORBIACEAE.)

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ABSTRACT

Croton bonplandianumBaill and Micrococcamercurialis (L).Benthbelonging to Euphorbiaceae were distinguished apart from their ethanobotanicalvalues,for which its morphological and characters are included. The present study was undertaken in complete morphology and anatomical characters of leaf, stem, root of both the plants. Morphological features was observed in leaf, stem,root , fruit with seed. Anatomical features were noted by rotary microtome sections and free hand safranin stained sections, and examined under bright field microscope. Both the plants posses the common features like calcium oxalatecrystals distributed in leaf,well representedvascular bundles in petiole, leaf, stem and root. Their distinct features like vasculature in petiole, sclerenchyma, lactifers are observed only in Croton bonplandianum.,andMicrococcamercurialishas advance organization of phloem elements concentric ,amphicribralvascularisation in leaf and stem, no sclerenchyma , prominent bicollateral vasculature in wing-bundlesof petiole.Leaf lamina showed loosely arranged spongy parenchyma with wide air-space. The root shows oxidative hermidin blue layer with crushed cortex. These anatomical results are helpful to learn more about Claoxylonfeaturesin family Euphorbiaceae .

KEYWORDS :Amphicribral ,Ethanobotinal ,Hermidin, Lactifers , Mesophyll, Petiole , Sclerenchyma,

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Original Article

INTRODUCTION

Each plant have some unique characters to make its identity clear from others *Croton bonpladianum*Baill and *Micrococcamercurialis* (L) Benth are common weedsbelongs to family Euphorbiaceae.

Complexity in habitat range and variability in morphology and genetics has made Euphorbiaceae classification difficult. The leaves are mostly alternate but may be opposite or whorled and they may be simple, compound and sometimes highly reduced. Stipules are present but may be reduced to glands or spines. Flowers are unisexual and usually actinomorphic.They may be highly reduced by suppression of parts, in extream form consisting of naked stamen as a staminate flower and a naked pistil as a pistillate flower. A specialized type of miniature inflorescence occurs in about 1,500 species comprising the genera Euphorbia.It consisitsof a single stamen. These flowers are all enclosed in cup –like involucre that is provided with peripheral nectarines and petalloid appendages such that the whole aggregations closely resemble a single flower(R.Elumalai et al.,2014).Extra floral nectaries are also common.The hairs are diverse and include glandular and non-glandular(C.R. Metcalfe and L.Chalk,1957) .The enumeration of several anatomic features like wood structure, laticifer type, trichomes and nature of stomata as being important for family classification, while other like pollen

nuclear, exine structures, type of pollination and inflorescence types are important for classifying genera, tribes and subfamilies(Yuvraj D. Adsul, Raghunath T. Mahajan and Shamkant B. Badgujar 2013).

Croton is a genus comprising around 1,300 species, widespread in tropicalregions of the Old and New Worlds.Several species have a long role in the traditional use of medicinalplants in Africa, Asia and South America. Popular uses include treatment of cancer, constipation,diabetes, digestive problems, dysentery, external wounds, fever, hypercholesterolemia, hypertension,inflammation, intestinal worms, malaria, pain, ulcers and weight-loss. Several species of *Croton* have a red sap, in some species containing proanthocyanidinsand/or alkaloids. The latter may betaspine or some of several benzylisoquinoline-like compounds. Diterpenes are very common in *Croton*, corresponding to clerodanes, cembranoid, halimanes, kauranes, labdanes, phorbol esters,trachylobanes and sarcopetalanes.(Antonio Salatino,* Maria L. FariaSalatino and Giuseppina Negri. 2007).

*Micrococca*is a genuscomporising 18 species, a native to tropical Africa.Most are herbs,but some are succulent and resemble cacti. Itis a wild food plant contributing to local household food and livelihood(Jeyachandradan .R ,Bastin 2013). The whole plant is used to treat children with fever and the plant- sap is instilled into the nose, eyes, or ears to treat headache, filariarisof the eye or otitis, respectively(Yuvraj D. Adsul, Raghunath T. Mahajan and Shamkant B. Badgujar 2013).The phytochemical screening analysis showed the presence of alkaloids, phenols, amino acids, diterpenesterpenoids, proteins, oxalate, cardiac glycosides, xanthoproteins, anthocyanin and saponin (Sai Prasanna C. G,., Poongani .M and Karpagam .S Phytochemical content of the leaf, stem and root of Micrococcamercurialis (L.)Benth. A promising herb.IOSR Journal of Pharmacy and Biological Sciences Volume 10, Issue 3 Ver. II (May - Jun. 2015), PP 24-27

MATERIALS AND METHODS

Plant Material

Healthy plants for studies have collected in Queen Mary'S College for *Micrococcamercurialis* (L) Benth (Reg .no. PARC/2015/3092) and *Croton bonplandianum* Baill was collected from agricultural fields of Nellikuppam , Kancheepuram District. The plant materials was authenticated by Prof. Jayaraman, Director , Plant Anatomy Research Centre (PARC) Chennai 45.

Macroscopic Evaluation

Macroscopic characters like habitat, habit, shape, size, morphology of the two plants including their vegetative, reproductive and embryonic structures were observed.

Microscopic Evaluation

Different parts of the plant, such as leaf (midrib and lamina), petiole, stem, rhizome and roots were fixed in FAA (Formalin: Acetic acid: 70% Ethanol; 5:5:90) for 24 hrs. After fixation the specimens were washed, dehydrated by passing through Tertiary butyl alcohol (TBA) series following the procedure of Sass, 1940. After dehydration, the specimens were infiltrated with paraffin wax (melting point 56-58°C) ad embedded in the paraffin blocks. Sections were cut using Rotary microtome at a thickness of 10µm. Sections were stained with Toluidine blue (0.01%) aqueous solution. Photomicrographs were prepared with Nikon trinologular microscope and Nikon digital camera.

The saffri n stained free hand sections are taken for studying the cortex layers and vascular bundle organization only in *Micrococcamercurialis*. It was observed under various magnifications (10x, 20x, 40x and 100x) of trinocular

microscope and pictures are captured accordingly.

RESULT AND DISCUSSIONS

Macroscopic Evaluation

Croton bonplandianum. Baill is a wildweed seen in open dry land. It is a small annual bushy ,woody herb grows upto a feet with strong , taproots with less or no tertiary roots.Its stem are thick ,woody with nodes and internodes.Dichotomous branching is observed.Leaves arepulvinate at base, petiolate, stipulate, arranged alternately on stem, lanceolate, serrate, acute at apex, herbaceous in nature,reticulate veination,dorsiventral. Inflorescenceare terminal in occurrence.The male flower is borne on a thick cylindrical pedicel and in the axil of a thick bract.The flower has six free perianth members which are free and imbricate aestivation with many free stamens. The anthers aredithecous and two chambered.The pollen grains are spherical. The female flower has single inferior ovary, bicarpellary showing axileplacentation. Fruit is capsule.

Figure 1: Croton Bonplandianum Habit

Micrococcamercurialis (L).Benth is a weed grown under shady,moist places among Acalyphaindica. Its roots are thin,slender, taproot system with numerous tertiary roots. Stem is green, stiff, monopodial branching at nodes with excurrent growth. Leaves are petiolate, exstipulate, alternate, mosaic,serrate. Cuspidate,herbaceous,elliptic, pinnately reticulate in veination.Inflorescence is axillary,raceme,pedicillate. Flowers are minute and have peduncle, dioecious,male flowers arepedicillate axillary to female flowers in inflorescence with three purple anthers, monoadelphous. Female flowers are di ortri lobed ovary with tri-locular. Sepals three, petals absent,Fruitis capsule, purplish. Seeds are globose.

Figure 2: Micrococcamercurialis (L) Benth. Habit.

Microscopic Evaluation

Structure of the Leaf

Croton bonplandianum

The midrib of the leaf is planoconvex in sectional view, with flat adaxial side and semicircular wide abaxial part (Figure 3A). It is 480µm thick and 650 µm wide. The epidermal layer of the midrib is thin lent the cells are distinct, squarish in shape and thick walled. The ground tissue consists of angular fairly thick walled and compact parenchymatous cells. The palisade layer in horizontally transcurrent along the adaxial subepidermal part of the midrib.

The vascular strand is single,deeply bowl shaped. The bundle is endrach ,collateral and consists of several radial parallel lines of thick walled angular xylemelements..Phloem occurs along the lower part of the in small, circular discrete masses with narrow gaps in between (Figure 3A). Calcium oxalate crystals are seen regular are shaped live within in phloem parenchyma.The crystals are druses.The crystal layer is one or two cells thick.Sclerid layer was seen around the vascular bundle.

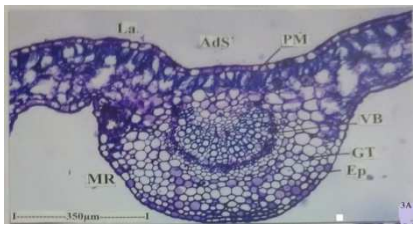

Figure 3 A: T.S. of leaf through Midrib - (AdS – Adaxial Side; Cr – Crystal ; Ep – Epidermis; GT – Ground Tissue;La – Lamina ; MR – Midrib ; Ph – Phloem ; PM – Palisade Mesophyll; VB- Vascular Bundle ; X – xylem

Micrococcamercurialis

The leaf consists of thick midrib and lateral vein(Figure 3B, 3Bi).The lamina is thin and soft.The midrib has adaxial thick dome shaped part much wider and slightly thick abaxial part. The midrib is 650µm thick and the adaxial dome is 220µm high and 400µm wide.The abaxial part is 1mm wide. The epidermal layer of midrib is thin and cells are small,spindle shaped and thin walled. The ground parenchyma cells of midrib consists of polygonal, compact thin walled parenchyma cells.The vascular bundle is flat and amphicribal , concentricbundles a primitive and rare vasculature (Katherine Esau 1965) (Figure 3Bi , Figure 3Bii).It includes several short thin vertical lines of xylem elements at the lower end of the xylem strands.The xylem elements are narrow,angular and thick walled (Figure 3Bii)The lateral view is similar to the midrib. It has adaxial dome, abaxial semicircular part and wedge shaped collateralcontinous vascular bundle. In lateral view is 400µm thick (Figure 3B, 3Bii). The cortex region shows several storage regions.

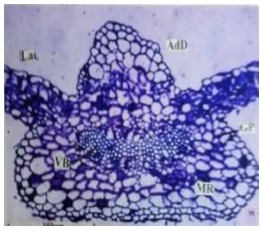

Figure 3B: Toluidine Blue Stained

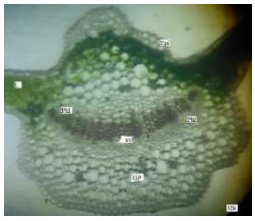

Figure 3 Bi: Safran in Stained T.S of Leaf through Midrib

Figure 3Bii: Vascular bundle of leaf).,(AdD – Adaxial Dome; Epi – Epidermis; GT- Ground Tissue; L, La – Lamina; MR – Mid Rib; GP – Ground Parenchyma; Xyl – Xylem; Phl – Phloem, VB – Vascular bundle

Structure of Lamina

Croton bonplandianum

The lamina is dorsiventral with adaxial palisade layer and abaxial spongy mesophyll zone. The lamina is 160µm thick. The adaxial rectangular epidermis cellsare thin with thick cuticle. Theabaxial epidermis consists of small squarish cells. The single row palisade cells are narrowly cylindrical and less compact .The spongy parenchyma cells are small, spherical or lobed and compact (Figure 4A).

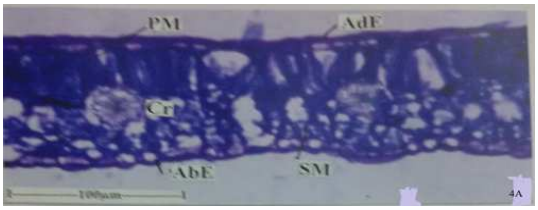

Figure 4 A: (T.S of Lamina)(AbE- Abaxial Epidermis ;AdE- Adaxial Epidermis ; Cr – Crystal ; LM- Leaf Margin; PM- Palisade Mesophyll ; MT- Mesophyll Tissue; SM – Spongy Mesophyll.)

Micrococcamercurialis

The lamina is dorsiventrally differentiated. The adaxial epidermis is thick and rectangular in shape .The abaxial epidermis is thin with cylindrical cells .The mesophyll tissue is differentiated into single row of cylindrical palisade cells which are widely separated from each other. There are three or four layers of spongy parenchyma cells which are loosely arranged forming wide air-space. A unique type thin,elongated scale –like calcium oxalate crystals seen in the mesophyll tissue. They are vertical or horizontal in orientation (Figure 4B). The crystals is 90µm long and 12µm wide.

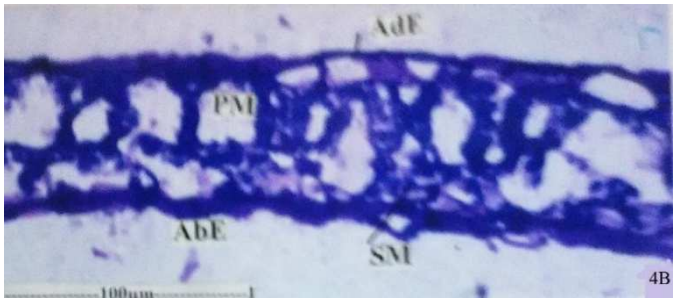

Figure 4B: T.S of Leaf through Leaf Margin.(AdE – Adaxial epidermis ; AbE – Abaxial Epidermis ; LM Leaf Margin; MT – Mesophyll Tissue: PM - Palisade Mesophyll; SM –Spongy Mesophyll; StC Styloid Crystal.)

Epidermal Tissue and Stomatal Morphology

Croton bonplandianum

The epidermal tissues was studied from paradermal sections of the lamina .The epidermal layer was viewed from above (surface view). The epidermal cells are small with thick, highly wavy anticlinal walls .The epidermal cells are smooth. Stomata are diffusely distributed (Figure 5A).The stomata are exclusively paracytic type .The epidermal cells are smooth (Figure 5A).The stomata has two subsidiary cells which are equal or unequal in size. The two cells lie on either side of the guard cells and are parallel to the long axis of the guard cells (Figure 5B).The guard cells are broadly elliptical stomatal pore is wide in size and measure 15 × 20µm in size. The stomatal pore is wide and elliptical in outline (Figure 5B).

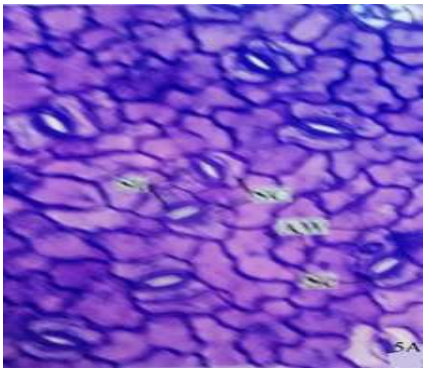

Figure 5A: Epidermal Tissue and Stomatal Morphology - Paradermal Tissue of the Lamina Show the Stomata and Epidermal Cells

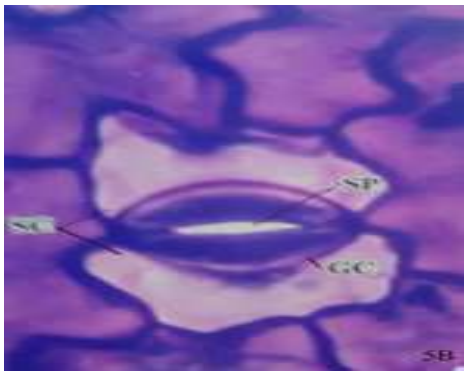

Figure 5B: Stomata and Epidermal Cells Enlarged. A Paracytic Stoma Enlarged(AW- Anticlinal Walls; EC- Epidermal Cells; GC- Guard Cells; SC – Subsidary Cells; St – Stomata; SP Stomatal Pore.)

Micrococcamercurialis

The paradermal section was observed to study the epidermal tissues .The epidermal cells as viewed from faceview,are highly lobed and amoeboid in outline.The anticlinal walls of the epidermal cells are undulated(Figure 5C) . The stomata areparacytic, fairly dense and diffuse in distribution .The cells are elliptical .There are two subsidiary cells for each stoma .They are on either side of the guard cells lying parallel to the long axis of the guard cells (Figure 5C). The guard cells are 30 µm ×20µm in size(Figure 5D)

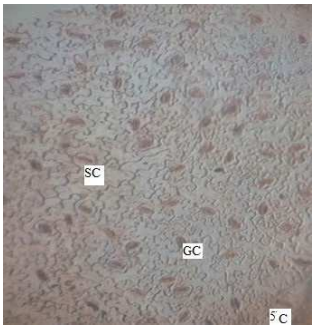

Figure 5C: Epidermal cells and Stomata Enlarged, Paradermal Section of the Lamina Showing Amoeboid Epidermal Cells and Stomata

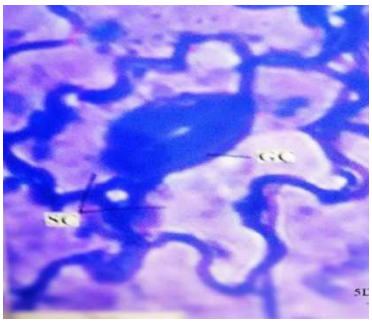

Figure 5D: A stoma with Parasitic Subsidiary Cells. (AW Anticlinal Wall; EC Epidermal Cell; GC – Guard Cell; SC – Subsidiary Cell; St – Stomata

Venation Pattern

Croton bonplandianum

The venation of the lamina is reticulate with thin lent,wall defined minor view . The vein-islets are rectangular to polygonal in outline. They have thin lent distinct boundaries. The veins are straight, within the vein islets are vein terminations .The terminations may be straight or undulated, simple (unbranched) or branched once or twice (Figure 6A). When the cleared laminals viewed under polarized light, large numbers of calcium oxalate crystals of druses are seen .The druses appear dark under normal light and appear bright white under polarized light (Figure 6B). The druses are 50 µm in diameter.

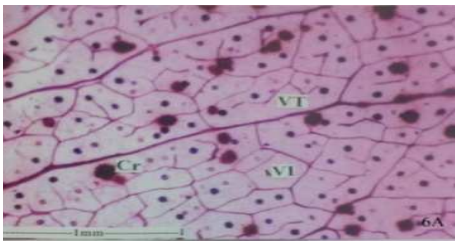

Figure 6A: Venation Pattern of the Lamina Vein islets and Vein Terminations Enlarged

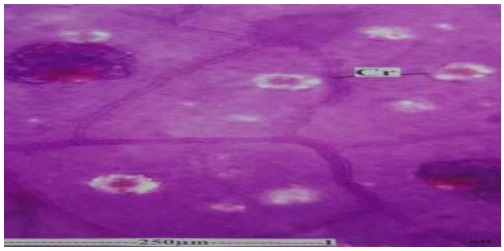

Figure 6B: Calcium Oxalate Druses in the Lamina (as Seen Under Polarised Light) (Cr Crystal; VI – Vein Islets; VT – Vein Terminations)

Micrococcamercurialis

The lateral veins and veinlets are much thin and wiry. They are uniform in thickness.The venation is lax;the vein-islets are well defined with distinct vein – boundaries. The vein – terminations are long, slender, either unbranched or branched once. The terminations are undulate (Figure 6C). Distributed in the mesophyll tissues are long, thin needle shaped calcium oxalate crystals ,whichare horizontal in orientation.(Figure 6D).

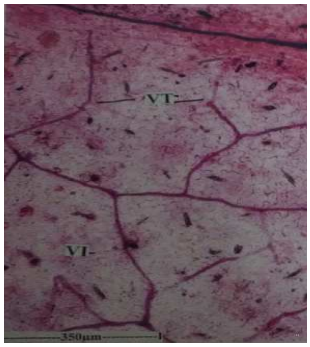

Figure 6C: Venation Pattern of the Lamina

Figure 6D: Needle Crystals Distributed in the Lamina (Under Polarized Light) (Cr- Crystal; VI – Vein Islet; VT – Vein Terminations

Structure of Petiole

Croton bonplandianum

The petiole is semicircular in sectional view with adaxial concavity and semicircular convexity on the abaxial part (Figure 7A). The petiole is 650 µm thick and 720 µm broad. It consisits of thin well defined spindle shaped epidermal cells. The ground tissue is homogenous and parenchymatous. The cells are circular / angular, thin walled and compact.The vascular system is multi stranded .These are about six vascular bundles arranged in a broad arc. There is a small bundle

located in the adaxial part of the arc, of the six bundles, the adaxial median bundle is the largest. Two lateral bundle are slightly smaller .The bundle beneath the wings and adaxial bundles are much smaller (Figure 7A). The larger bundles are flat and triangular in outline; the smaller bundle are circular or top shaped. They are all collateral. The xylem strands consists of about six radial multiple of cells.The smaller bundle have about three rows of xylem elements. Phloem occurs in small discrete groups In the ground tissue of the petiole occurs darkly stained lactifers which is surrounded by about six radially elongated cells which are called rosette cells (Figure 7A).

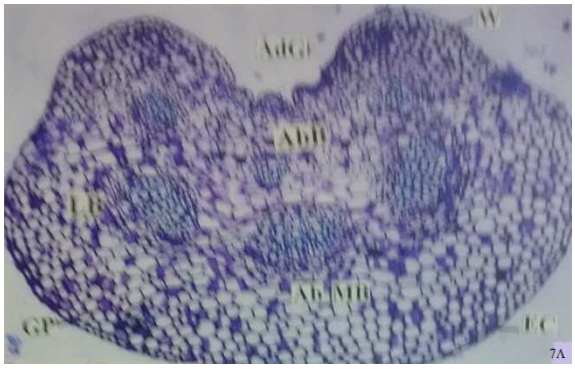

Figure 7A: T.S. of Petiole – Entire View. Vascular Bundles of the Petiole. (AdB Adaxial Bundle; AbMB Abaxial Median Bundle; EC – Epidermal Cells; GP- Ground Parenchyma; LB – Lateral Bundle ; Lf- Laticifer ;Ph Phloem ; RC – Rosette Cells ;W- Wing ; X- Xylem

Micrococcamercurialis

The petiole is dorsiventrallydifferentiated . It consists of semicircular convex abaxial part and flat or slightly raised adaxial part. There are two short, very thick hemispherical wings, one on either side of the adaxial part (Figure 7B, &7Bi).The median part of the petiole is 1.7mm thick and 2.5 mm wide.The lateral wings are 800µm in height and 700µm in thickness.

The epidermal layer of the petiole consists of fairly wide, rectangular, thick walled cells.The ground tissue is parenchymatous, the cells being thin walled, angular and compact. These are main system of vascular bundles located in the median part of the petiole. The main bundles are three in number and are arranged in an arc. The larger bundle is flat.The bundles are bicollateral,(Figure 7B and 7Bi) having xylem elements arranged in dense vertical thin lines and phloem elements located at both the end of the xylem.The Wing bundles are prominent, top –shaped and bicollateral , one on each wing smaller in size. The xylem elements are small, thick walled and are diffuse. Phloem occurs in semicircle cap on the both the sides of the xylem. (Figure 7Bi).

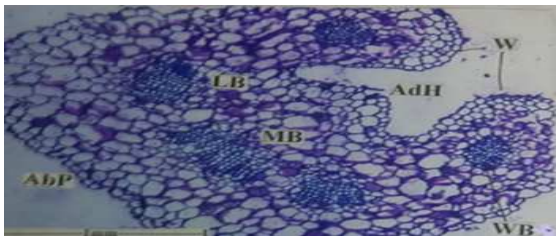

Figure 7B: Toluidine Blue Stained

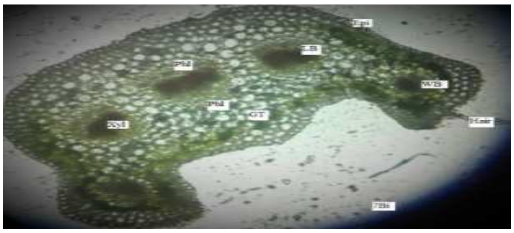

Figure 7Bi: Safran in Stained) – T.S of Petiole – Entire view,(Abp – Abaxial Part ; AdH – Adaxial Hump; Ep – Epidermis ; GT – Ground Tissue ; MB – Median Bundle; LB – Lateral Bundle ; W Wing ; WB – Wing Bundle

Structure of Stem

Croton bonplandianum

The stem is circular in cut view, measuring 1.8mm in diameter. It consists of an epidermal layer, cortical zone, secondary xylem and phloem and wide pith (Figure 8A).The epidermal layer includes a layer of spindle shaped, thick walled cells. The cortex has seven or eight layers of elliptical thick walled compact parenchyma cells located in the inner cortical portion are small clusters of sclerenchyma cells. Vascular bundle is endarch, collateral .Secondary xylem is 400µm thick. It consists of radially aligned lines of vessels. The vessels are circular to elliptical, thick walled and are solitary or in radial multiples (Figure 8A). The vessels are 20 µm wide.Xylem fibres are squarish in sectional view; they are in regular compact radial lines. The cells are thick walled and lignified (Figure 8A). Secondary phloem occurs in a continuous cylinder enclosing the xylem. The phloem elements are in short radial lines (Figure 8A). Pith is reduced.

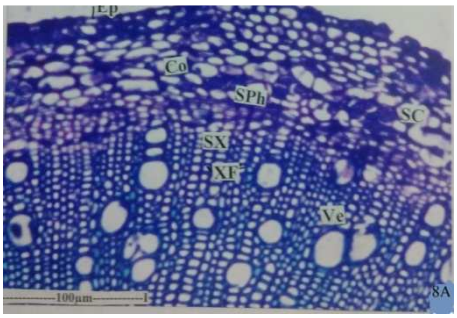

Figure 8A: T.S of Stem –Secondary Phloem and Secondary Xylem Enlarged. (Co- Cortex ; SC –Sclerenchyma Cells; Sph –Secondary Phloem; SX – Secondary Xylem ; Ve- Vessel ; XR – Xylem Ray ; XF – Xylem Fibres.)

Micrococcamercurialis

The stem is roughly circular in sectional view. It is 2.6mm thick. It consists of an intact epidermal layer, narrow cortical zone, hollow thick vascular cylinder enclosing parenchymatous pith (Figure 8Bi, Figure 8Bii).The epidermal layer consists of rectangular fairly thick walled cells. The cortical zone consists of about 6 layers of wide, angular and compact parenchyma cells in which 3 layers of colourless spongy parenchyma with storage materials, followed by 3 layers of spongy chlorenchyma is observed(Figure 8Bi).Vascular Bundle is open endarch. Phloem is compactly arranged as continuous layers enclosing the xylem on both the sides(Figure 8Bi). Concentric, amphicribral vascular bundles a primitive and rare vasculature (Katherine Esau 1965). The secondary phloem includes outer discontinuous layer of small groups of phloem fibres, narrow sieve elements and phloem parenchyma cells. The phloem elements occur in short , radial segments separated from each other radially oblong rectangular parenchyma cells. Secondary xylem is 600µm thick walls. The long , radial multiple vessel are angular in outline with think walls upto 30µm in diameter. The xylem fibres are angular ,

lignified , thick walled. The cell lumen is wide .The xylem rays are. The secondary phloem includes outer discontinuous layer of small groups of phloemfibres .The phloem tissue includes narrow sieve elements and phloem parenchyma cells. Thepholem elements occur in short, radial segments separated from each other by radially oblong rectangular parenchyma cells (Figure 8B, Figure 8Bii). Pith is wide and shows storage of food materials.

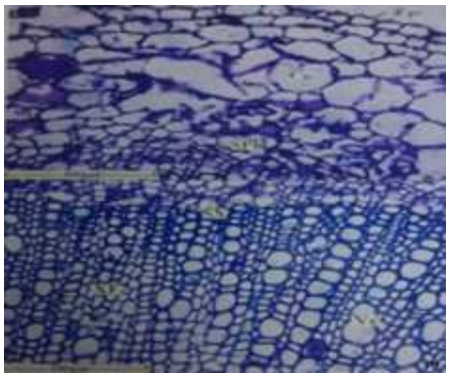

Figure 8B

Figure 8Bi

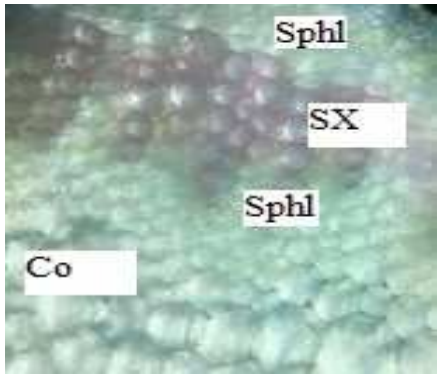

Figure B ii

Figure 8B: (Toluidine blue stained, Figure 8B i – safranin stained ,) – T.S of Stem – A sector Enlarged. (Figure 8Bii: Vascular bundle enlarged.)(Co – Cortex ; Pi – Pith ; Sph – Secondary Pholem ; SX – Secondary Xylem.),(Co – Cortex ; Ep – Epidermis ;SPh – Secondary Pholem ; SX- Secondary Xylem ; Ve – Vessels ; XF – Xylem Fibres).

Strucutre of Root

Croton Bonplandianum

The root is rough with irregular fissures on the surface. The root measuring 950µm thick was studied. The root exihibits slightly excentric growth with more amount of secondary growth on one side than the opposition side (Figure 9A).The periderm is irregular ruptured forming shallow wide fissures .The cells of the periderm is also compressed into wavy cell layers. The cortical zone is narrow and the cortical cells intact at certain regions and collapsed into dark portions in other regions.Secondary phloem is well preserved It includes parenchyma cells and sieve elements associated with the companion cells (Figure 9A). The phloem elements are wide and thick walled.Secondary Xylem consists of diffusely distributed vessels in the ground tissue of xylem fibres. The vessels in the central part of the root are narrow and those towards the periphery are wider (Figure 9A). The vessels are solitary, circular and thick walled is 50µm in diameter .The xylem fibres are highly thick walled and lignified. The fibre lumen is narrow.The cells compact and dense.

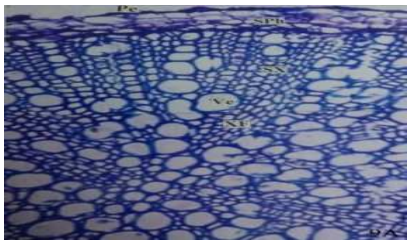

Figure 9A: T.S of Root ,A sector enlarged – Secondary Phloem and Secondary xylem portions enlarged. (SPh – Secondary Phloem; SX- Secondary Xylem ; Ve –Vessels; XF – Xylem Fibres

Micrococcamercurialis

The epidermal layer of root is crushed into thick, dark circular line. There is a thin less prominent white periderm, comprising 2 or 3 layers of cells (Figure 9Bi). Cortical zone is not evident,and it was observed that specific 3 or 4 crushed layers of elongated cells which turns blue on prolonged exposure to air before glycerine is applied in saffrin stained

sections (Figure 9Bi).Thisis due to presence of hermidin as reported in *Micrococcaperennis*(G. A. Swan 1984). Secondary phloem is narrow which includes a thin layer which includes small discrete groups of sieve elements. The secondary xylem measures 1.9mm in diameter. It occupies the major portion of the root. The secondary xylem consists of vessels and fibres. The vessels are distinct in several radial lines. Most of the vessels are in radial multiples. The vessels vary in shape from circular to angular outline.The cell walls of the vessels are thick (Figure 9B). The xylem fibres are squarish or rectangular in sectional view. They also occur in compact radial lines. The fibres have wide lumen and thick lignified walls (Figure 9B).

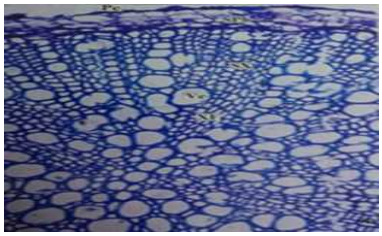

Figure 9B

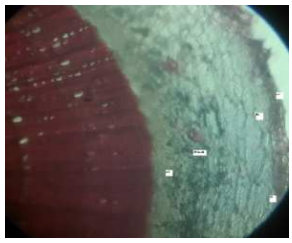

Figure 9Bi

(Figure 9B: Vascular bundle toluidine blue stained) (Figure 9Bi- safranin stained), T.S. of Root – A section enlarged. Epi – Epidermis, Co – Cortex ; Pe, P – Periderm ; Sph , Phl – Secondary Pholem ; SX- Secondary Xylem ; Ve – Vessel ; XF – Xylem fibre , Hermidin – Hermidin layer turns blue on oxidation

Structure of Fruit

Croton bonplandianum

The fruit consist of a thick and hard pericarp which is differentiated into outer epicarp , middle mesocarp and inner endocarp (Figure 10A). The epicarp consists of outer thin layer of small squarish thick walled cells and inner layer of vertically oblong short thick walled ells. The middle layer comprises vertically oblong, pillar like columnar,thick walled palisade cells. The innermost part of the pericarp includes two layers of prismatic cells which obliquely vertical in orientation (Figure 10 B). Total thickness of the pericarp is 190µm.

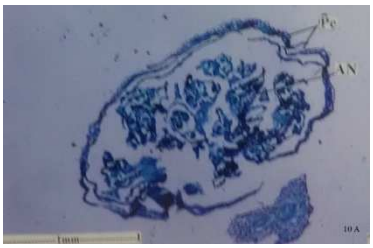

Figure 10 A: T.S of Fruit with Carpels and Seed Coat

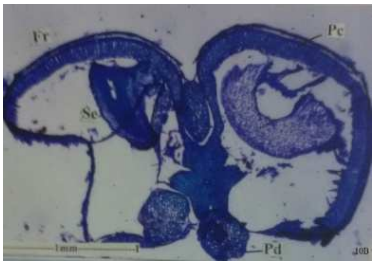

Figure 10 B: L.S of Fruit showing the pedicel with two carpels.
(Fr – fruit; Pd – Pedicel ; PC – Pericarp ; Se –Seed ; SC – SeedCoat.)

Micrococcamercurialis

The fruit istricarpellary and syncarpous .The mature fruit is coccus and includes dry, thick pericarp which enclose the single seed in each carpel (Fig 10C). The pericarp includes outer highly dilated epidermal layer of unequal cells. Inner to the epidermis is a narrow zone of parenchymatous cells. The third zone of the pericarp includes very thick vertically elongated columnar macrosclereids.The innermost boundary includes 2 or 3 layers of parenchyma cells (Fig 10D). The pericarp is 250 µm thick.

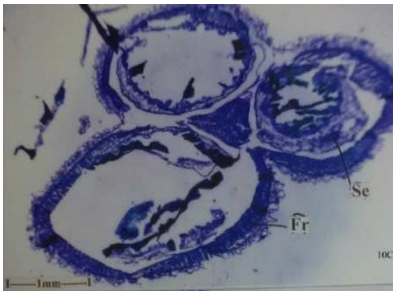

Figure 10 C: T.S of Fruit Showing Tricarpellary Coccus

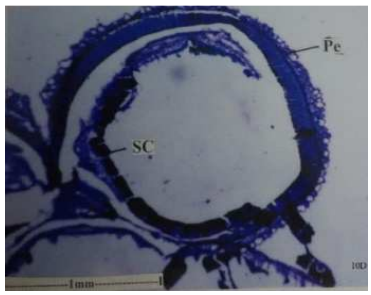

Figure 10D: One Carpel Enlarged.(Fr – Fruit; Pe – Pericarp ; SC- Seed Coat ; Se – Seed

Structure of Seed

Croton bonplandianum

The seed is thick and elliptical in outline measuring 1.2 mm in horizontal plane and 1.5 mm in vertical plane (Figure 11A). The testa is 320µm thick.The seed coat consists of outer epidermis which has vertically oblong narrow thick walled cells inner to the epidermal layer is a thick cylinder thin walled parenchyma cells which is sarcotesta . The innermost part of the seed coat is the thick , narrow , vertically elongated sclerenchyma cells called sclerotesta (Figure 11B). The sclerotesta is 230µm thick.

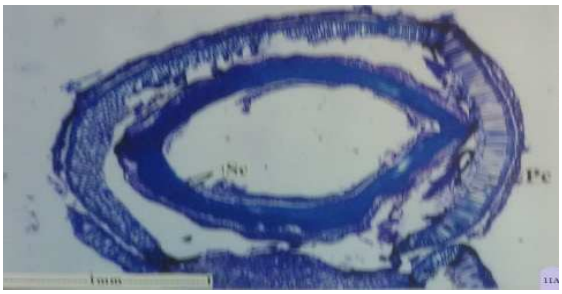

Figure 11A: L.S of Seed

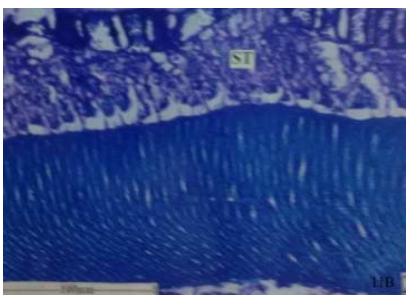

Figure 11B: Seed coat LS enlarged (Ep – Epidermis; ST- Sarcotesta; ScT – Sclerotesta)

Micrococcamercurialis

The seedcoat is thin and measures 100µm in thickness.It consists of an outer zone of epidermal layer and inner several semicircular thick ridges.The inner zone has several semicircular ridges .The ridges of the inner zone fits into the furrows of the outer zone (Figure11D).Within the seed is seen the embryo. The embryo is club shaped. It consists of spherical embryo and cylindrical radical.(Figure 11C).

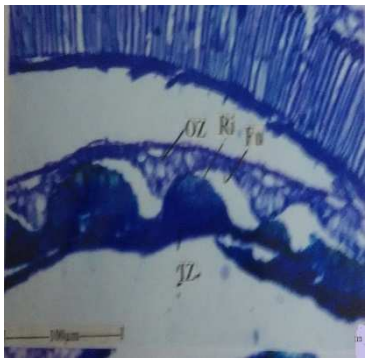

Figure 11C **Figure 11 D**

Figure 11C: Embryo located within the Seed.(Figure 11 D: Seed Coat T.S Enlarged (Ep – Epidermis; Em – Embryo; Fu – Furrow; EC- Epidermal Cell; IZ – Inner Zone. OZ - Outer Zone; PSc – Palisade Sclereids; Ri – Ridges; Se – Seed.)

The anatomical structure exhibits a wide range of variation in correalation with the diversity of habit. Leaf exhibit a varied internal structure in correlation with diversity of external form. Simple epidermis, non-glandular hairs in *Croton* to mucilaginous epidermis, stalked multicellular glandular hairs seen in *Tragia.* Stomata is usually confined to lower region except in *Crotoneae*, it diverse in occurrence and distribution, *Micrococcamercurialis* were noted for paracytic,anomocytic, anisocytic and diacytic type however paracytic is predominant(Patrick Kabouw, Peter.C, et al 2008). Mesophyll layer has 1-2 layers of palisade and spongy parenchyma with sclerenchymatous elements. Dehay observed four main types of petiolar variations in vascular structure, among which closed vascular cylinder which is semicircular xylem and phloem in adaxial and xylem, phloem flat plate on abaxialclosing the gap between the ends of abaxial arc which is regarded as basic characteristic of Euphorbiaceae family. An open vascular ends with very much incurved, along with additional wing vasculars are seen in Tragia. Special type of crystals called sphaerites are secreted in mesophyll of Croton either in groups or solitary. In *Claoxylon*styloids are present in phloem of both leaf and stem (mesophyll).According to Pax and Hoffmann(1673) the roughness of leaf *Claoxylon* is due to large size of crystalliferous cells(C.R. Metcalfe and L.Chalk,1957)The dried leaves of *Micrococca* are not rough because the styloids do not perforate the epidermis during drying hence dry leaves remain soft (Patrick Kabouw, Peter.C, Van Welzen, 2014)In stem xylem in the form of a continuous cylinder traversed by narrow ray in all genera.Pith is sclerosed in *Croton.* Vessel are moderate in size, usually it occurs in numerous multiples of 2or3 cells or often multiples of 4 or more. In root the xylem is surrounded by cambium and phloem(C.R. Metcalfe and L.Chalk,1957). Thus fewer major anatomical characteristic features between *Croton* and *Claoxylon (Micrococca ,Tragia*) from review of literature.

*Croton bonplandianum.*Baillia weed of dry agricultural land with bushy appearance white flower terminal inflorescence, capsule as fruit. It anatomical features that suits its adaptations like small stomatal pore to cut down the transpiration, Calcium oxalate crystals are metabolic end products synthesized in leaf provides more medicinal potent to leaf, petiole with lactifers shows leaf has biodrug capability, sclerenchyma in stem keeps the stem rigid and strong and

stores food , lignified xylem fibres with smaller lumen in root helps in effective water transportation in dry fields . Fruit has three layers of pericarp so it is thick and rigid.

Micrococcamercurialis.(L)Benth is a slender herb , grown in shady moist place, with axillary green inflorescence with inconspicuous male flower, green coccus capsule as fruit . The leaf and stem shares same type of concentric, amphicribral vasculature which is observed in this species. Leaf has wide air space inmesophyll and also big stomatal guard cells that helps in respiration. No sclerenchymatous layer is observed which serves the plant to be slender.Petiole has advance vasculature pattern three vascular bundles in in midrib region and two in wings. The vascular bundles are bicollateral. Leaf and veins has calcium oxalate layers which provides bio-drug potent to this herb. Root shows a peculiar character of changing into blue on long exposure to air due hermidin. Xylem fibres of root has wide lumen shows less rigid in nature. Fruit has only three layers of pericarp so it is tender

CONCLUSIONS

The above anatomical studies are useful for easy identification, taxonomic position and for authentication of these plants for their drug potency.

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